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Notice of Allowability

Application No.

10/695,285

Applicant(s)

JACOBS ET AL.

Examiner

Jennifer M. Dolan

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Amdt of 6/28/05.
2. ☒ The allowed claim(s) is/are 1-8, 10, 11 and 21-24.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|--|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____. |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

DETAILED ACTION

Election/Restrictions

1. This application is in condition for allowance except for the presence of claims 12-20 to an invention non-elected without traverse. Accordingly, claims 12-20 have been cancelled.

Examiner's Amendment

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

Claims 12-20 have been canceled

Allowable Subject Matter

3. Claims 1-8, 10-11, and 21-24 are allowed.
4. The following is an examiner's statement of reasons for allowance:

The primary reason for allowance is the claimed sequence of forming an interconnect line on a tungsten plug, and then discharging the tungsten plug by contacting the interconnect line with a gas-introduced liquid.

The closest prior art of record (see for example, U.S. Patent No. 6,777,742 to Wang) teaches method steps substantially similar to the claimed method, including forming the tungsten

Art Unit: 2813

plug, forming interconnect lines over the tungsten plug, discharging the plug, and then removing residual polymers. The prior art, however, teaches discharging the tungsten plugs by usage of ionic or electrolytic solutions, rather than the claimed gas-introduced liquid solution, and furthermore, provides no suggestion or motivation for discharging the tungsten plugs using a gas-introduced liquid.

Although the prior art does suggest the usage of non-corrosive cleaning solutions of gas-introduced liquids, such as CO₂-injected water (see US 5,336,371 to Chung, 2003/0006513 to Gotoh, or US 2002/0053355 to Kamikawa) and ozone-injected water (see US 6,851,873 to Muraoka or US 2002/0036001 to Ise, noting that ozone water is not necessarily even capable of discharging a tungsten plug), these solutions are presented as solutions for either replacing deionized water for post-fabrication rinsing, or as a resist removing solution. There is no suggestion in the prior art that a gas-injected liquid solution could be advantageously used for discharging a tungsten plug, nor is there any suggestion that such a solution should be applied to a semiconductor device after the processing steps involved in forming an interconnect layer (typically deposition and etching of a metal layer).

Since the claimed method steps provide the advantages of using an efficient and non-hazardous solution for discharging a tungsten plug while preventing the corrosion of the plug during a polymer removal step, and since there is no suggestion in the prior art of discharging a tungsten plug by applying a gas-introduced liquid after forming an interconnect line, it is the Examiner's opinion that the claimed method steps would not have been obvious to a person having ordinary skill in the art.

Art Unit: 2813

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

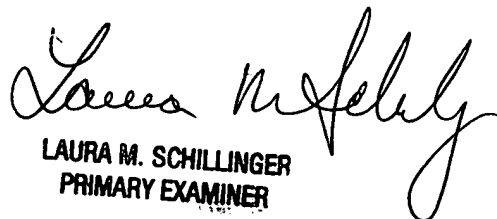
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd


LAURA M. SCHILLINGER
PRIMARY EXAMINER